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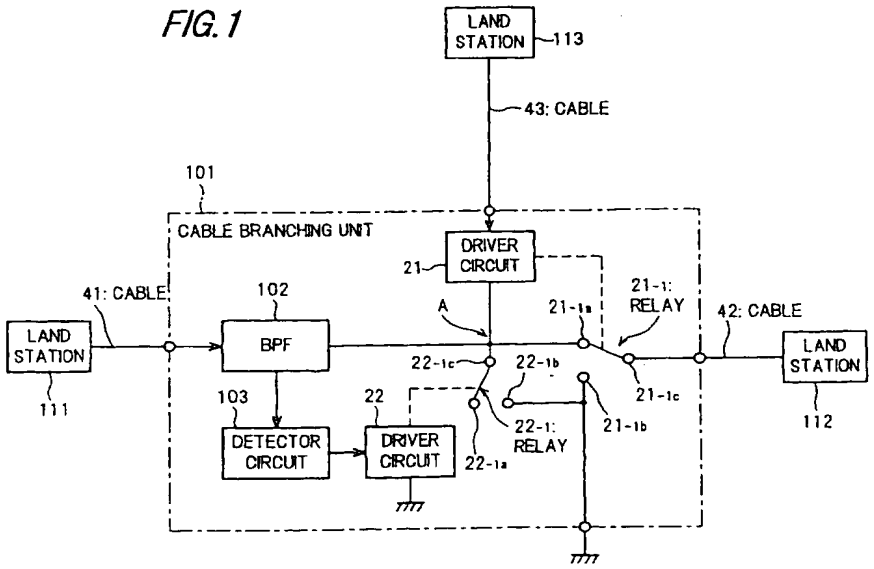
(54) Cable branching unit

(57) A cable branching unit which enables signals to be exchanged through normal cables without suspending the power supply even when a short mode short circuit fault occurs in a cable branching from the cable branching unit, in which the cable branching unit for branching a first cable (41) into a second and a third cable (42 and 43) includes a BPF band pass filter (102) for extracting a control signal multiplexed among signals transmitted from the first land station through the first cable (41), and a relay (22 and 22-1) for short-circuiting, to ground, one or both of the cables (42) connected to the second land station (112) and the cable (43) connected to the third land station (113), in accordance with the control signal extracted by the BPF (102).

FIG. 1



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Description

[0001] The present invention relates to a cable branching unit which is suitable for use with a cable, for example a submarine cable, for branching electric or optical signals transmitted through the cable.

[0002] Cable faults, which may be caused in a submarine cable system, for example, may have two modes. One is called an open mode, wherein a cable is broken at a fault point and a current flowing through the cable between two land stations is interrupted.

[0003] The other is called a short mode, wherein a cable is short-circuited to the ground due to contact with seawater, for example, at a fault point and a current from a land station is caused to flow out at the fault point.

[0004] A previously proposed arrangement will now be described with reference to a block schematic diagram shown in Fig. 3 of the accompanying drawings.

[0005] In Fig. 3 there is shown a branching unit 301 in a submarine cable system for branching a cable 41 connected to a first land station 111 into two cables 42 and 43 connected to a second and a third land station 112 and 113 respectively. The cable branching unit 301 includes a driver circuit 21 connected between the cable 41 and the cable 43 and a relay 21-1 driven by the driver circuit 21. Other components for branching transmission signals, such as a branch amplifier, are omitted for simplification from the drawings.

[0006] The relay 21-1 has a contact point 21-1a connected to the cable 41, a contact point 21-1b connected to ground and a common terminal 21-1c connected to the cable 42. When the relay 21-1 is driven by the driver circuit 21, the common terminal 21-1c is connected to the contact point 21-1b, while the common terminal 21-ic is connected to the contact point 21-la when the driver circuit 21 is disabled.

[0007] When the submarine cable system is working normally, a power supply current is supplied between the first and the third land stations 111 and 113 through the driver circuit 21, which drives the relay 21-1 to connect the cable 42 to ground, and another power supply current is supplied between the second land station 112 and ground.

[0008] When an open mode fault is caused at a point on the cable 43 between the cable branching unit 301 and the land station 113, the power supply current flowing through the cable 43 is cut-off and the driver circuit 21 is disabled. Therefore, the common terminal 21-1c of the relay 21-1 is connected to the contact point 21-1a and includes a power supply circuit between the first land station 111 and the second land station 112 through the cable branching unit 301.

[0009] Thus, signal transmission between the first and the second land stations 111 and 112 can be maintained, even when an open mode fault is caused on the cable 43 branching from the cable branching unit 301 towards the third land station 113.

[0010] However, when a short mode fault is caused by a short circuit at a point on the cable 43 branching from the previously proposed cable branching unit 301, the current from the first land station 111 is allowed to flow out from the fault point which is grounded. Therefore, any signal transmission towards the cable branching unit 301 must be suspended until the fault point is repaired, which means the suspension of the power supply to any repeaters provided on the cable 41 between the first land station 111 and the cable branching unit 301 in a cable system wherein transmission signals are multiplexed on the same cable for supplying the power supply current, resulting in the breakdown of the whole system.

[0011] A feature of arrangements to be described below, by way of example in illustration of the present invention is that there is a cable branching unit which enables signals to be exchanged through normal cables without suspending the power supply even when a short mode fault is caused in a cable branching from a cable branching unit.

[0012] In a particular arrangement to be described by way of example in illustration of the present invention, a cable branching unit for use in branching a cable connected to a first land station into a cable connected to a second land station and a cable connected to a third land station, includes a control signal extracting means for extracting a control signal multiplexed among signals transmitted through the first cable from the first land station, and a short-circuiting means for short-circuiting, to ground, one or both of the cables connected to the second land station and the cable connected to the third land station, in accordance with the control signal extracted by the control signal extracting means.

[0013] The control signal extracting means may be a band-pass-filter for passing only a frequency component of a frequency which is assigned to the control signal.

[0014] The short-circuiting means may include a first driver circuit enabled by a current flowing through the cable connected to the third land station, a first relay for connecting the cable connected to the second land station to ground when the first driver circuit is enabled, and for connecting the cable connected to the second land station to a node when the first driver circuit is disabled, the node being coupled to the cable connected to the first land station through the control signal extracting means and coupled to the cable connected to the third land station through the first driver circuit, a second relay for short-circuiting the node to the ground when the second relay is driven, and a second driver circuit for driving the second relay when the frequency component of the frequency assigned to the control signal is extracted by the control signal extracting means.

[0015] When a plurality of cable branching units is to be provided in a cable system at certain intervals, the frequency band of the band-pass filter of any of the cable branching units is designed to be different from the frequency band of the band-pass-filter of any other

of the cable branching units.

[0016] In another arrangement to be described below, by way of example in illustration of the invention, a cable branching unit for branching a cable including an optical cable connected to a first land station into a cable connected to a second land station and a cable connected to a third land station includes an optical control signal extracting means for extracting an optical control signal multiplexed among optical signals transmitted through the optical cable from the first land station, and a short-circuiting means for short-circuiting, to ground, one or both of the cables connected to the second land station and the cable connected to the third land station, in accordance with the optical control signal extracted by the optical control signal extracting means.

[0017] The optical control signal extracting means in this arrangement includes an optical band-pass-filter for passing only a wavelength component of a wavelength that is assigned to the optical control signal.

[0018] The short-circuiting means may include a first driver circuit enabled by a current flowing through the cable connected to the third land station, a first relay for connecting the cable connected to the second land station to ground when the first driver circuit is enabled, and for connecting the cable connected to the second land station to a node when the first driver circuit is disabled, the node being coupled to the cable connected to the first land station through the control signal extracting means and coupled to the cable connected to the third land station through the first driver circuit, a second relay for short-circuiting the node to the ground when the second relay is driven, and a second driver circuit for driving the second relay when the wavelength component of the wavelength assigned to the optical control signal is extracted by the optical control signal extracting means.

[0019] When a plurality of cable branching units is to be provided in a cable system at certain intervals, a wavelength band of the optical band-pass filter of any one of the cable branching units is designed to be different from a wavelength band of the optical band-pass-filter of any other of the cable branching units.

[0020] Therefore, the exchange of signals between the first and the second land station can be maintained with the power supply provided between the first land station and ground, and the power supply provided between the second land station and ground, even when a short mode short circuit fault is caused on the power supply cable branching from the cable branching unit.

[0021] The following description and drawings disclose, by means of examples, with reference to Figs. 1 and 2 of the accompany drawings the invention which is characterised in the appended claims, whose terms determine the extent of the protection conferred hereby.

[0022] In the drawings: -

Fig. 1 is a block schematic diagram illustrating a cable branching unit 101, and

Fig. 2 is a block schematic diagram illustrating another cable branching unit 201.

[0023] Referring to Fig. 1, a first, a second and a third land station 111, 112 and 113 are connected with each other by way of the cable branching unit 101 through cables 41, 42 and 43, respectively, in a similar way to that described with reference to the cable branching unit 301 of Fig. 3.

[0024] In the cable system of Fig. 1, the first land station 111 has the function of transmitting a control signal multiplexed in the transmission signals through the cable 41.

[0025] The cable branching unit 101 includes a BPF (Band-Pass-Filter) 102 connected between the cable 41 and a node A, a detector circuit 103, a second relay 22-1 and a second driver circuit 22, in addition to a first relay 21-1 and a first driver circuit 21 connected between the node A and the third land station 113 through the cable 43. The first relay 21-1 which is driven by the first driver circuit 21 has a first and a second contact point 21-1a and 21-1b connected to the node A and ground, respectively, and a common terminal 21-1c connected to the second land station 112 through the cable 42. The first relay 21-1 and the first driver circuit 21 operate in a similar way to the driver circuit 21 and the relay 21-1 of Fig. 3, and duplicated descriptions are therefore omitted.

[0026] The BPF 102 extracts the control signal from multiplex signals transmitted from the first land station 111. The control signal extracted by the BPF 102 is supplied to the detector circuit 103. The second driver circuit 22, which is connected between an output terminal of the detector circuit 103 and ground, drives the second relay 22-1 when the control signal is detected by the detector circuit 103. The second relay 22-1 has a first and a second contact point 22-1a and 22-1b and a common terminal 22-1c. The common terminal 22-1c is connected to the node A and contacted to the second contact point 22-1b connected to ground when the second relay 22-1 is driven by the second driver circuit 22.

[0027] When the cable system is working normally, a power supply current is supplied between the first land station 111 and the third land station 113 flowing through the first driver circuit 21, and another power supply current is supplied between the second land station 112 and ground.

[0028] When an open mode fault is caused at a point on the cable 43, the first driver circuit is disabled and the common terminal 21-1c of the first relay 21-1 is connected to the node A through the first contact point 21-1a, for enabling the power supply current to be supplied between the first and the second land stations 111 and 112, in a similar way to that described above with reference to the cable system of Fig. 3.

[0029] When a short mode fault is caused at a point on the cable 43 connected to the third land station 113,

the power supply current from the first land station 111 is able to flow out from the fault point which is short-circuited to ground.

[0030] Detecting the short mode short circuit fault, the first land station 111 transmits a control signal of a predetermined frequency, in the arrangement of Fig. 1, which is extracted by the BPF 102 of the cable branching unit 101 and detected by the detector circuit 103.

[0031] The second driver circuit 22 is enabled by the output of the detector circuit 103 when the control signal is detected and the common terminal 22-1c of the second relay 22-1 is connected to the second contact point 22-1b. Therefore, the node A is connected to ground through the second relay 22-1, enabling power supply current to be supplied between the first land station 111 and ground, in disregard of the short mode short circuit fault caused on the cable 43.

[0032] As to the first relay 21-1, the common terminal 21-1c is switched to the first contact point 21-1a, as the first driver circuit 21 is disabled. However, the first contact point 21-1a of the first relay 21 is connected to ground through the node A and the second relay 22-1. Therefore, the power supply between the second land station 112 and the ground is maintained as it is.

[0033] Thus, the signal exchange between the first and the second land stations 111 and 112 can be maintained through the cables 41 and 42 with the power supply provided between the first land station 111 and ground, and the power supply provided between the second land station 112 and ground, even when a short mode short circuit fault occurs on the cable 43 branching from the cable branching unit 101 in the arrangement of Fig. 1.

[0034] In a cable system having more than one cable branching unit, a control signal each having a different respective frequency may be assigned to each of the cable branching units by preparing the frequency band of the BPF 102 of each of the cable branching units to correspond to the frequency of a respective one of the control signals.

[0035] The control signal from the first land station may be transmitted through a cable other than the cable used for supplying the power supply current.

[0036] In the cable system of Fig. 2, a first land station 211 and a third land station 213 are connected to the cable branching unit 201 through a cable 51 and a cable 53, respectively. The cable 51 includes an optical cable 51a and a power supply cable 51b, and the cable 53 includes an optical cable 53a and a power supply cable 53b.

[0037] The cable branching unit 201 has a similar configuration to that of the cable branching unit 101 of Fig. 1, except that an optical coupler 205, an optical BPF 202 and a photoelectric transducer 203 are provided in place of the BPF 102 and the detector circuit 103 of Fig. 1.

[0038] The optical cable 51a and the optical cable 53a are connected by way of an optical coupler 205, whereby a part of the optical signal is branched and supplied to the optical BPF 202.

[0039] The optical BPF 202 extracts a predetermined wave-length component to be supplied to the photoelectric transducer 203 from the optical signals supplied from the optical coupler 205.

[0040] The photoelectric transducer 203 generates an electric signal to be supplied to the second driver circuit 22 in accordance with the optical signal supplied from the optical BPF 202.

[0041] The power supply cable 51b from the first land station 211 is connected to the node A, which is connected to the power supply cable 53b through the first driver circuit 21.

[0042] In the arrangement of Fig. 2, an optical control signal is transmitted from the first land station 211, when a short mode short circuit fault occurs at a point on the cable 53, the control signal being multiplexed in the optical signals transmitted through the optical cables 51a and 53a, a part of which is branched towards the optical BPF 202. Only the wave-length component of the optical control signal is extracted by the optical BPF 202. The second driver circuit 22 is enabled with the output of the photoelectric transducer 203 and the common terminal 22-1c of the second relay 22-1 is connected to the second contact point 22-1b, when the wave-length component of the optical control signal is supplied to the photoelectric transducer 203.

[0043] Therefore, the signal exchange between the first and the second land stations 111 and 112 can be maintained with a power supply provided between the first land station 111 and ground, and a power supply provided between the second land station 112 and ground, even when a short mode short circuit fault is caused on the power supply cable 53b branching from the cable branching unit 201, in a similar way to that described with reference to Fig. 1.

[0044] When more than one cable branching unit is to be provided in a cable system of the type described with reference to Fig. 2, an optical control signal having a respective different wave-length may be assigned to each of the cable branching units by arranging that the wave-length band of the optical BPF 202 of each of the cable branching units corresponds to the wave-length of a respective one of the optical control signals, in a similar way to that described with reference to Fig. 1.

[0045] It will be understood that, although particular arrangements have been described by way of example in illustration of the invention, variations and modifications thereof as well as other arrangements may be conceived within the scope of the appended claims.

Claims

1. A cable branching unit (101) for use in branching a cable (41) connected to a first land station (111) into a cable (42) connected to a second land station (112) and a cable (43) connected to a third land sta-

tion (113), wherein the cable branching unit (101) includes a control signal extracting means (102) for extracting a control signal multiplexed among signals transmitted through the first cable (41) from the first land station (111), and a short-circuiting means (21, 21-1, 22 and 22-1) for short-circuiting, to ground, one or both of the cable (42) connected to the second land station (112) and the cable (43) connected to the third land station (113), in accordance with the control signal extracted by the control signal extracting means (102).

2. A cable branching unit (101) as claimed in claim 1 wherein the control signal extracting means (102) includes a band-pass-filter for passing only a frequency component of a frequency which is assigned to the control signal.

3. A cable branching unit (101) as claimed in either claim 1 or claim 2 wherein the short-circuiting means (21, 21-1, 22 and 22-1) includes a first driver circuit (21) enabled by a current flowing through the cable (43) connected to the third land station (113) and a first relay (21-1) for connecting the cable (42) connected to the second land station (112) to ground when the first driver circuit (21) is enabled, and for connecting the cable (42) connected to the second land station (112) to a node (A) when the first driver circuit (21) is disabled, the node (A) being coupled to the cable (41) connected to the first land
station (111) through the control signal extracting means (102) and coupled to the cable (43) connected to the third land station (113) through the first driver circuit (21).

4. A cable branching unit (101) as claimed in claim 3 wherein the short-circuiting means (21, 21-1, 22 and 22-1) includes a second relay (22-1) for short-circuiting the node (A) to ground when the second relay (22-1) is driven.

5. A cable branching unit (101) as claimed in claim 4 including a second driver circuit (22) for driving the second relay (22-1) when the frequency component of the frequency assigned to the control signal is extracted by the control signal extracting means (102).

6. A plurality of cable branching units provided in a cable system at certain intervals, each unit having a configuration as claimed in any one of claims 2 to 5, wherein a frequency band of the band-pass filter of any one of the cable branching units is different from a frequency band of the band-pass-filter of any other of the cable branching units.

7. A cable branching unit (201) for use in branching a cable (51) including an optical cable (51a) connected to a first land station (211) into a cable (42) connected to a second land station (112) and a cable (53) connected to a third land station (213), wherein the cable branching unit (201) includes an optical control signal extracting means (205 and 202) for extracting an optical control signal multiplexed among optical signals transmitted through the optical cable (51a) from the first land station (211), a short-circuiting means (21, 21-1, 22 and 22-1) for short-circuiting, to ground, one or both of the cables (42) connected to the second land station (112) and the cable (53) connected to the third land station (113), in accordance with the optical control signal extracted by the optical control signal extracting means (205 and 202).

8. A cable branching unit (201) as claimed in claim 7 wherein the optical control signal extracting means (205 and 202) includes an optical band-pass-filter (202) for passing only a wavelength component of a wavelength that is assigned to the optical control signal.

9. A cable branching unit (101) as claimed in either claim 7 or claim 8 wherein the short-circuiting means (21, 2 1-1, 22 and 22-1) includes a first driver circuit (21) enabled by a current flowing through the cable (53) connected to the third land station (213), and a first relay (21-1) for connecting the cable (42) connected to the second land station (112) to ground when the first driver circuit (21) is enabled, and for connecting the cable (42) connected to the second land station (112) to a node (A) when the first driver circuit (21) is disabled, the node (A) being coupled to an electric cable included in the cable (51) connected to the first land station (211) and coupled to an electric cable included in the cable (53) connected to the third land station (213) through the first driver circuit (21).

10. A cable branching unit (201) as claimed in claim 9 wherein the short-circuiting means (21, 21-1, 22 and 22-1) includes a second relay (22-1) for short-circuiting the node (A) to ground when the second relay (22-1) is driven.

11. A cable branching unit (201) as claimed in claim 10 including a second driver circuit (22) for driving the second relay (22-1) when the wavelength component of the wavelength assigned to the optical control signal is extracted by the optical control signal extracting means (205 and 202).

12. A plurality of cable branching units provided in a cable system at certain intervals, each unit having a configuration as claimed in any one of claims 8 to 11, wherein a wavelength band of the optical band-

pass filter of any of the cable branching units is designed to be different from a wavelength band of the optical band-pass-filter of any other of the cable branching units.

FIG. 1

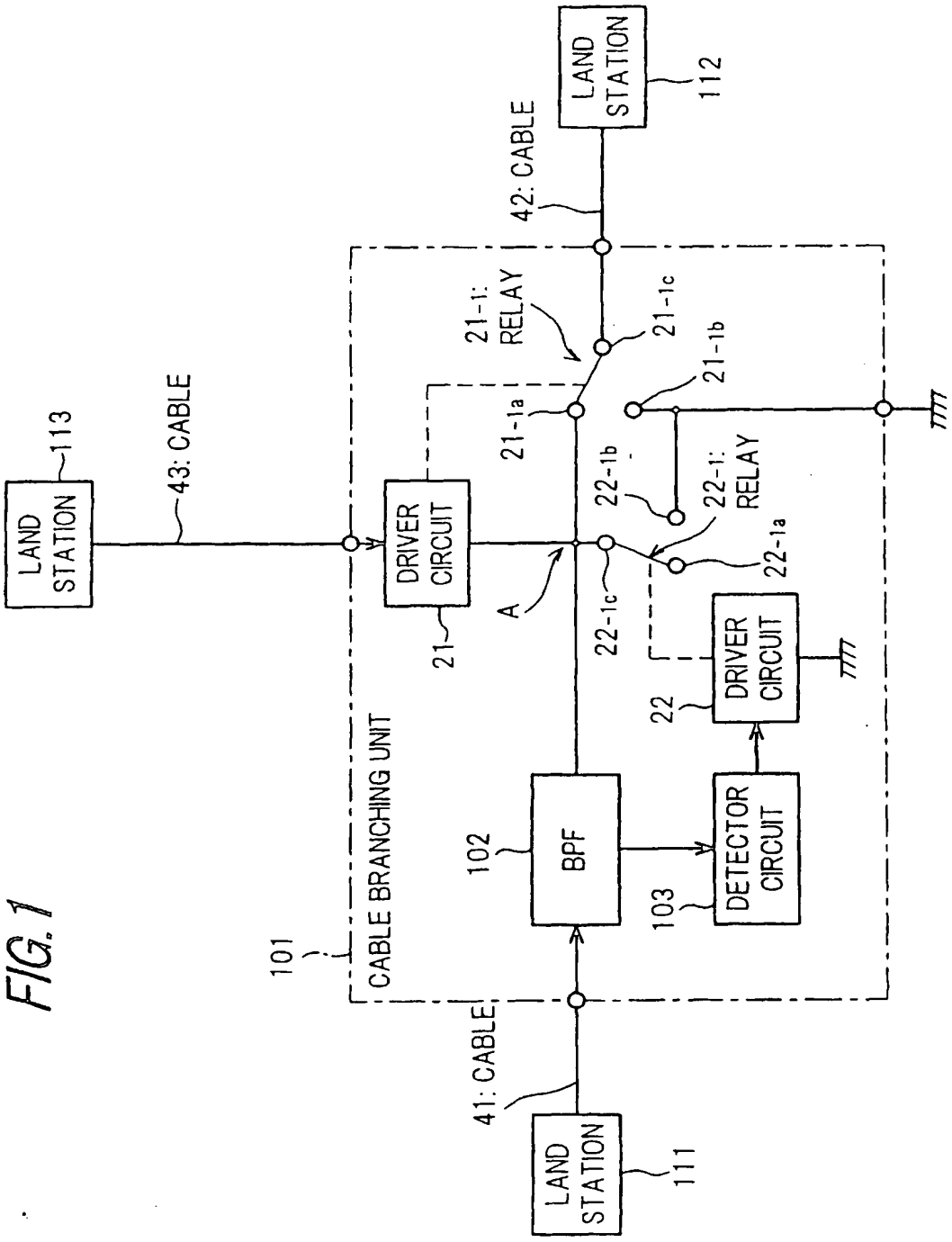
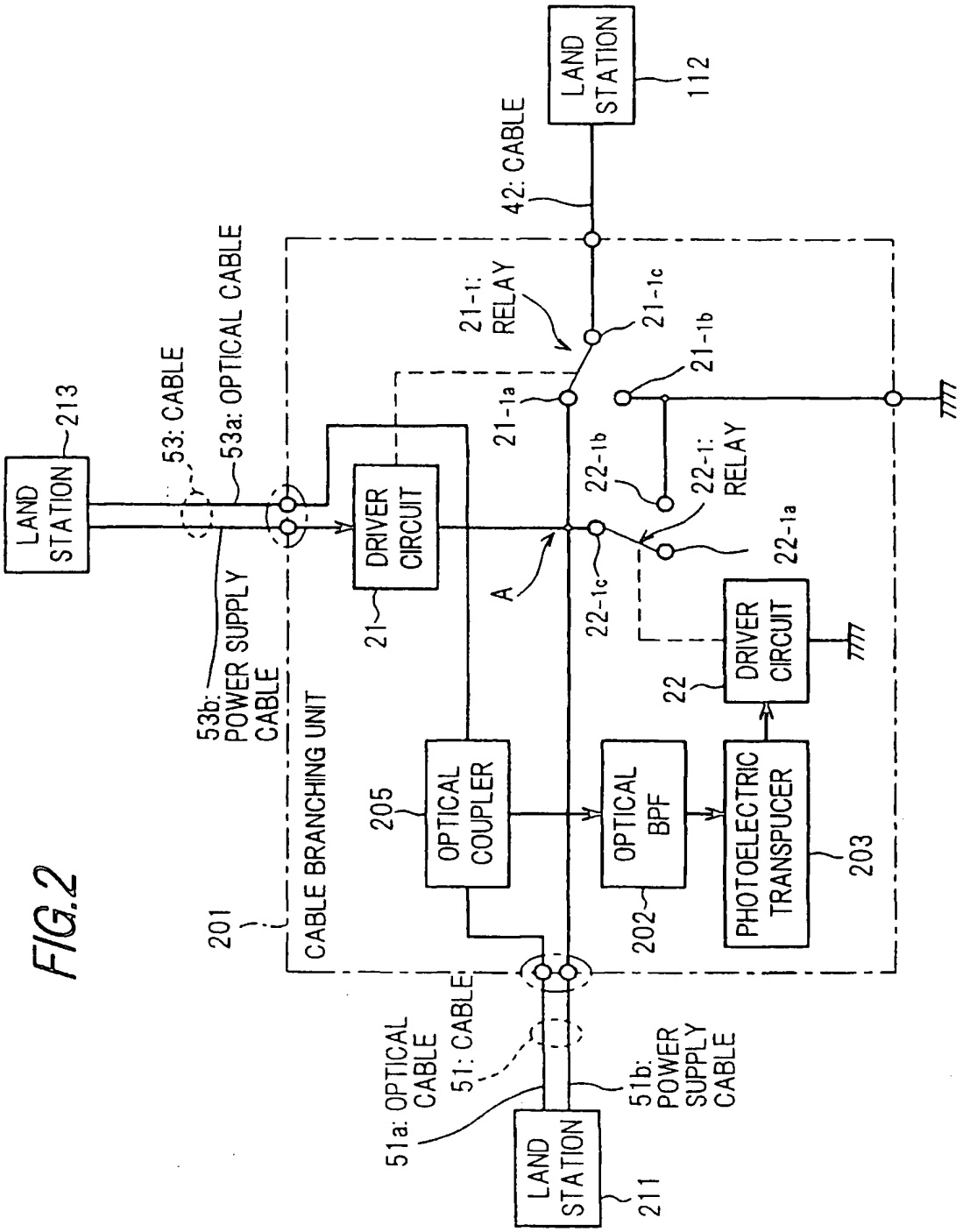


FIG.2



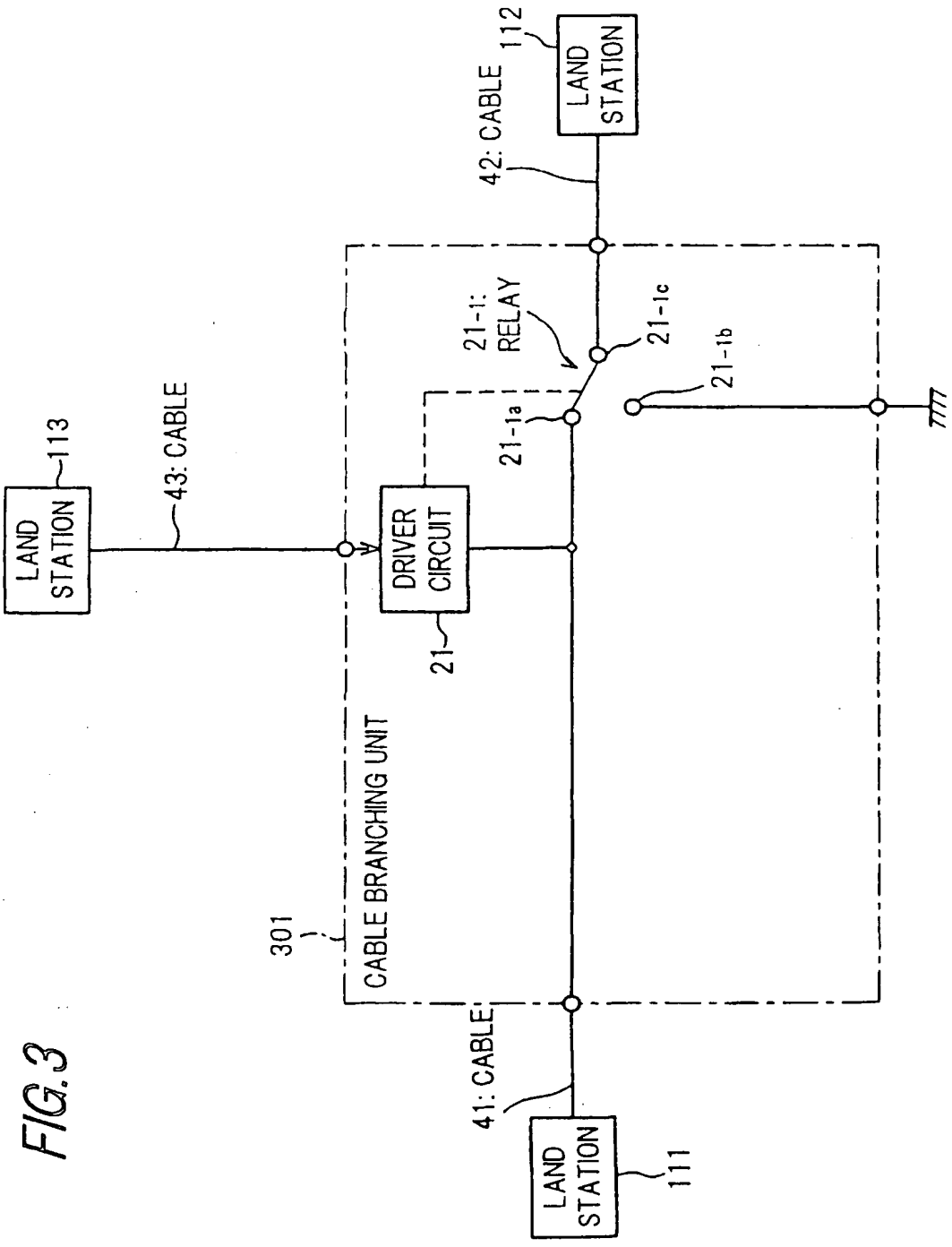


FIG. 3